

New Hampshire Volunteer Lake Assessment Program

2003 Biennial Report for Perkins Pond Sunapee



NHDES
Water Division
Watershed Management Bureau
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OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **PERKINS POND, SUNAPEE**, the program coordinators have made the following observations and recommendations:

As part of the state's lake survey program, DES biologists performed a comprehensive lake survey on **PERKINS POND** this summer. Publicly-owned recreational lakes/ponds in the state are surveyed approximately every ten to fifteen years. In addition to the tests normally carried out by VLAP, biologists tested for certain indicator metals and nitrogen, created a map of the lake/pond bottom contours (referred to as a bathymetric map), and mapped the abundance and distribution of the aquatic plants along the shoreline. DES biologists will also sample the lake/pond once during the Winter of 2003-2004. Some data from this lake survey have been included in this report and has been added to the historical database for your lake/pond. If you would like a complete copy of the raw data from the lake survey, please contact the DES Limnology Center at (603) 271-3414 or (603) 271- 2658. A final report should be available in 2005 and a copy will be available at any state library.

Thank you for your continued hard work sampling the lake/pond this season! Your monitoring group sampled **6** times this season! As you know, with multiple sampling events each season, we will be able to more accurately detect changes in water quality. Keep up the good work!

FIGURE INTERPRETATION

- **Figure 1 and Table 1:** The graphs in Figure 1 (Appendix A) show the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix B) lists the maximum, minimum, and mean concentration for each sampling season that the lake/pond has been monitored through the program.

Chlorophyll-a, a pigment naturally found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration measured in the water gives an estimation of the algal concentration or lake productivity. **The mean (average) summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 7.02 ug/L.**

The current year data (the top graph) show that the chlorophyll-a concentration **increased consistently** from May to August, **decreased greatly** from August to September, and then **decreased slightly** from September to October. The chlorophyll-a concentration in May, June, September, and October was **much less than** the state mean. The chlorophyll-a concentration July was **slightly greater than** the state mean, and in August (10.46 ug/L) it was **greater than** the state mean.

The historical data (the bottom graph) show that the 2003 chlorophyll-a mean is **less than** the state mean.

Overall, the statistical analysis of the historical data (the bottom graph) shows that the mean annual chlorophyll-a concentration has **not significantly changed** since monitoring began in **1987**. Specifically, the chlorophyll-a concentration has **fluctuated** (but has not *continually increased* or *continually decreased*) since monitoring began. (Note: Please refer to Appendix E for the detailed statistical analysis explanation and data print out.)

While algae are naturally present in all lakes/ponds, an excessive or increasing amount of any type is not welcomed. In freshwater lakes/ponds, phosphorus is the nutrient that algae depend upon for growth. Algal concentrations may increase with an increase in nonpoint sources of phosphorus loading from the watershed, or in-lake sources of phosphorus loading (such as phosphorus releases from the sediments). Therefore, it is extremely important for volunteer monitors to continually educate residents about how activities within the watershed can affect phosphorus loading and lake/pond quality.

- **Figure 2 and Table 3:** The graphs in Figure 2 (Appendix A) show historical and current year data for lake/pond transparency. Table 3 (Appendix B) lists the maximum, minimum and mean transparency data for each sampling season that the lake/pond has been monitored through the program.

Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. **The mean (average) summer transparency for New Hampshire's lakes and ponds is 3.7 meters.**

The current year data (the top graph) show that the in-lake transparency **remained relatively stable** from May to October.

Overall, the statistical analysis of the historical data (the bottom graph) show that the mean annual in-lake transparency has **not significantly changed** (either *increased* or *decreased*) since monitoring began in **1987**. Specifically, the in-lake transparency has **remained between approximately 2 and 3 meters** since monitoring began. (Note: Please refer to Appendix E for the statistical analysis explanation and data print out.)

Typically, high intensity rainfall causes erosion of sediments into lakes/ponds and streams, thus decreasing clarity. Efforts should continually be made to stabilize stream banks, lake/pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the lake/pond. Guides to Best Management Practices designed to reduce, and possibly even eliminate, nonpoint source pollutants, such as sediment loading, are available from DES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix A) show the amounts of phosphorus in the epilimnion (the upper layer) and the hypolimnion (the lower layer); the inset graphs show current year data. Table 8 (Appendix B) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the lake/pond has joined the program.

Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Too much phosphorus in a lake/pond can lead to increases in plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 11 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration **decreased very slightly** from May to June, **increased consistently** from June to September, and then **decreased** from September to October. The phosphorus concentration in August and September was **greater than** the state median.

The historical data show that the 2003 mean epilimnetic phosphorus concentration is **approximately equal to** the state median.

The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration **decreased very slightly** from May to June, **increased** from June to July, and then **remained stable** from July to October. The phosphorus concentration on each sampling event was **less than** the state median.

Overall, the statistical analysis of the historical data show that the phosphorus concentration in the epilimnion (upper layer) and the hypolimnion (lower layer) has fluctuated, but has **not significantly changed** (either *continually increased* or *continually decreased*) since monitoring began in **1987**. (Note: Please refer to Appendix E for the statistical analysis explanation and data print out.)

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about its sources and how excessive amounts can adversely impact the ecology and value of lakes and ponds. Phosphorus sources within a lake or pond's watershed typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands.

TABLE INTERPRETATION

➤ Table 2: Phytoplankton

Table 2 (Appendix B) lists the current and historic phytoplankton species observed in the lake/pond. The dominant phytoplankton species observed in the August plankton sample were ***Dinobryon* (a golden-brown algae), *Rhizosolenia* (a diatom), and an unidentifiable Dinoflagellate species.**

Phytoplankton populations undergo a natural succession during the growing season (Please refer to the "Biological Monitoring Parameters" section of this report for a more detailed explanation regarding seasonal plankton succession). Diatoms and golden-brown algae are typical in New Hampshire's less productive lakes and ponds.

➤ **Table 2: Cyanobacteria (Blue-green algae)**

Small amounts of the cyanobacterium *Microcystis* was observed in the plankton sample this season. ***This species, if present in large amounts, can be toxic to livestock, wildlife, pets, and humans.***

Cyanobacteria can reach nuisance levels when excessive nutrients and favorable environmental conditions occur. During September of 2003, a few lakes and ponds in the southern portion of the state experienced cyanobacteria blooms. This was likely due to nutrient loading to these waterbodies. As mentioned previously, many weeks during the Spring and Summer of 2003 were rainy, which likely resulted in a large amount of nutrient loading to surface waters.

The presence of cyanobacteria serves as a reminder of the lake's/pond's delicate balance. Watershed residents should continue to act proactively to reduce nutrient loading into the lake/pond by eliminating fertilizer use on lawns, keeping the lake/pond shoreline natural, re-vegetating cleared areas within the watershed, and properly maintaining septic systems and roads.

In addition, residents should also observe the lake/pond in September and October during the time of fall turnover (lake mixing) to document any algal blooms that may occur. Cyanobacteria (blue-green algae) have the ability to regulate their depth in the water column by producing or releasing gas from vesicles. However, occasionally lake mixing can affect their buoyancy and cause them to rise to the surface and bloom. Wind and currents tend to "pile" cyanobacteria into scums that accumulate in one section of the lake/pond. If a fall bloom occurs, please contact the VLAP Coordinator.

➤ **Table 4: pH**

Table 4 (Appendix B) presents the in-lake and tributary current year and historical pH data.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 5.5 severely limits the growth and reproduction of fish. A pH between 6.5 and 7.0 is ideal for fish. The mean pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is **6.5**, which indicates that the surface waters in state are slightly acidic. For a more detailed explanation regarding pH, please refer to the "Chemical Monitoring Parameters" section of this report.

The mean pH at the deep spot this season ranged from **6.83** in the hypolimnion to **6.82** in the epilimnion, which means that the water is ***slightly acidic***.

Due to the presence of granite bedrock in the state and the deposition of acid rain, there is not much that can be done to effectively increase lake/pond pH.

➤ **Table 5: Acid Neutralizing Capacity**

Table 5 (Appendix B) presents the current year and historic epilimnetic ANC for each year the lake/pond has been monitored through VLAP.

Buffering capacity or ANC describes the ability of a solution to resist changes in pH by neutralizing the acidic input to the lake. The mean ANC value for New Hampshire's lakes and ponds is **6.7 mg/L**, which indicates that many lakes and ponds in the state are "highly sensitive" to acidic inputs. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

The Acid Neutralizing Capacity (ANC) of the epilimnion (the upper layer) continues to remain ***less than*** the state mean this season. Specifically, the mean ANC was **5.17 mg/L**, which indicates that the pond is ***highly sensitive*** to acidic inputs (such as acid precipitation).

➤ **Table 6: Conductivity**

Table 6 (Appendix B) presents the current and historic conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current. The mean conductivity value for New Hampshire's lakes and ponds is **62.1 uMhos/cm**. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

A statistical analysis of the epilimnetic conductivity data was conducted to quantify the change in in-lake conductivity since monitoring began. Overall, the statistical analysis of the historical data show that the mean annual epilimnetic conductivity has ***significantly increased*** since monitoring began. Specifically, the epilimnetic conductivity has ***increased*** (meaning ***worsened***) on average by ***approximately 3.2 percent*** per sampling season during the sampling period **1987 to 2003**. (Note: Please refer to Appendix E for the statistical analysis explanation and data print out.)

It also appears that the conductivity in the Inlet has increased since being monitored starting in 1993.

Typically, sources of increased conductivity are due to human activity. These activities include septic systems that fail and leak leachate into the groundwater (and eventually into the tributaries and the lake/pond), agricultural runoff, and road runoff (which contains road salt during the spring snow melt). New development in the watershed can alter runoff patterns and expose new soil and bedrock areas, which could contribute to increasing conductivity. In addition, natural sources, such as iron deposits in bedrock, can influence conductivity.

➤ **Table 8: Total Phosphorus**

Table 8 (Appendix B) presents the current year and historic total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae's ability to grow and reproduce. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

The total phosphorus concentration in **Inlet** this season was **relatively low** (annual mean of 5 ug/L). However, this station has had a history of **elevated and fluctuating** total phosphorus concentrations.

➤ **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**

Table 9 (Appendix B) shows the dissolved oxygen/temperature profile(s) for the 2003 sampling season. Table 10 (Appendix B) shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

The dissolved oxygen concentration was **high** at all depths sampled at the deep spot of the lake/pond. Typically, shallow lakes and ponds that are not deep enough to stratify into more than one or two layers will have relatively high amounts of oxygen at all depths. This is due to continual lake mixing and diffusion of oxygen into the bottom waters induced by wind and wave action.

➤ **Table 11: Turbidity**

Table 11 (Appendix B) lists the current year and historic data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the “Other Monitoring Parameters” section of this report for a more detailed explanation.

The turbidity levels in the deep spot and inlet samples this season were ***relatively low***.

➤ **Additional Comments:**

The Department of Environmental Services (DES) has been requested by the Town of Sunapee, the Perkins Pond Protective Association (PPPA) and other watershed residents to conduct a Diagnostic Feasibility Study (DFS) for Perkins Pond. DES has agreed to perform the study, with local assistance.

Much of the Perkins Pond shoreline is densely developed with small lots, and there has been growing concern that old and poorly functioning septic systems may be causing accelerated eutrophication of the pond. A proposal for a bond issue to extend town sewer to Perkins Pond residents has been presented to Sunapee voters four times, in 1999, 2000 (twice), and 2001, and failed each time.

The primary desired study outcome is to provide an analysis to determine the water quality benefits of extending the Sunapee sewer line to the Perkins Pond shoreline, and to evaluate existing and future land use and septic system conditions for impacts to the trophic condition of the pond.

The project goal is to maintain a stable lake trophic state and stable lake quality trends. A secondary desired study outcome is scientific documentation of sedimentation problems, and recommendations to remediate or mitigate sediment accumulation in the pond.

The study will estimate Total Phosphorus (TP) loadings to Perkins Pond through the use of models to estimate loadings from various sources, calibrating the estimated existing TP loadings through actual field measurements. Once estimates of TP loading are determined for current conditions, estimates for TP loading under future development and land use scenarios will be made.

The final report should be ready in the Fall of 2005.

DATA QUALITY ASSURANCE AND CONTROL

Annual Assessment Audit:

During the annual visit to your lake/pond, the biologist conducted a "Sampling Procedures Assessment Audit" for your monitoring group. Specifically, the biologist observed the performance of your monitoring group while sampling and filled out an assessment audit sheet to document the ability of the volunteer monitors to follow the proper field sampling procedures (as outlined in the VLAP Monitor's Field Manual). This assessment is used to identify any aspects of sample collection in which volunteer monitors are not following the proper procedures, and

also provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure that the samples that the volunteer monitors collect are truly representative of actual lake and tributary conditions.

Overall, your monitoring group did an **excellent** job collecting samples on the annual biologist visit this season! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the biologist to provide additional training. Keep up the good work!

Sample Receipt Checklist

Each time your monitoring group dropped off samples at the laboratory this summer, the laboratory staff completed a sample receipt checklist to assess and document if the volunteer monitors followed proper sampling techniques when collecting the samples. The purpose of the sample receipt checklist is to minimize, and hopefully eliminate, future re-occurrences of improper sampling techniques.

Overall, the sample receipt checklist showed that your monitoring group did a **very good** job when collecting samples this season! Specifically, the members of your monitoring group followed the majority of the proper field sampling procedures when collecting and submitting samples to the laboratory. However, the laboratory did identify one aspect of sample collection that the volunteer monitors could improve upon.

Sample Labels: On the **July** sampling event, an *E.coli* sample was submitted to the laboratory from an unspecified sampling location. Please remember to label all sample bottles. Furthermore, if you collect a sample from a new location that has not been sampled at in the past, you must submit a map which identifies the sample location. This will help us update our sampling map information.

NOTES

- **Monitor's Note (5/5/03):** We thought only E. Coli bottles contained acid. Therefore, all samples were taken blind as to whether the bottle contained acid or not.
- (6/2/03):** Please confirm that although marked otherwise, none of the small brown bottles actually contain acid.
- (7/7/03):** No flow at outlet; Inlet not sampled: no flow.

OBSERVATIONS AND RECOMMENDATIONS

2003

(8/4/03): Raining during sampling, mist to heavy downpour; lake looked murky

USEFUL RESOURCES

Acid Deposition Impacting New Hampshire's Ecosystems, ARD-32, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/ard/ard-32.htm.

Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials, NHDES-WD 97-8, NHDES Booklet, (603) 271-3503.

Camp Road Maintenance Manual: A Guide for Landowners. Kennebec Soil and Water Conservation District, 1992, (207) 287-3901.

Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/wmb/wmb-10.htm.

Erosion Control for Construction in the Protected Shoreland Buffer Zone, WD-SP-1, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-1.htm

Impacts of Development Upon Stormwater Runoff, WD-WQE-7, NHDES Fact Sheet, (603) 271-3503, or www.des.state.nh.us/factsheets/wqe/wqe-7.htm

Lake Protection Tips: Some Do's and Don'ts for Maintaining Healthy Lakes, WD-BB-9, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-9.htm.

Management of Canada Geese in Suburban Areas: A Guide to the Basics, Draft Report, NJ Department of Environmental Protection Division of Watershed Management, March 2001, www.state.nj.us/dep/watershedmgt/DOCS/BMP_DOCS/Goosedraft.pdf.

Proper Lawn Care In the Protected Shoreland, The Comprehensive Shoreland Protection Act, WD-SP-2, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-2.htm.

Road Salt and Water Quality, WD-WMB-4, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/wmb/wmb-4.htm.

Sand Dumping - Beach Construction, WD-BB-15, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-15.htm.

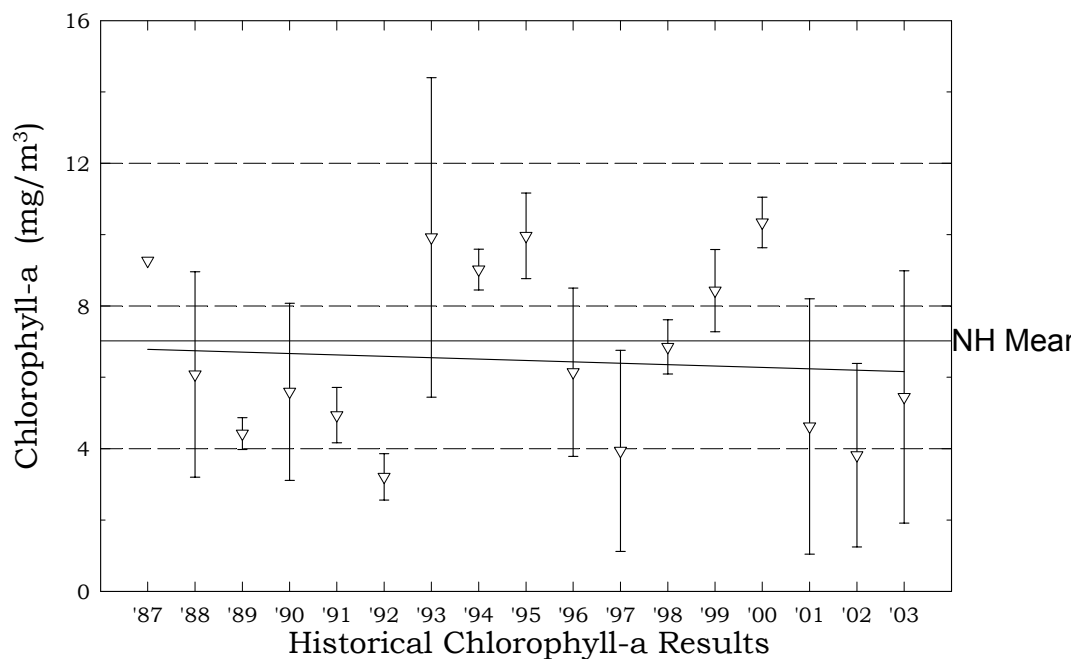
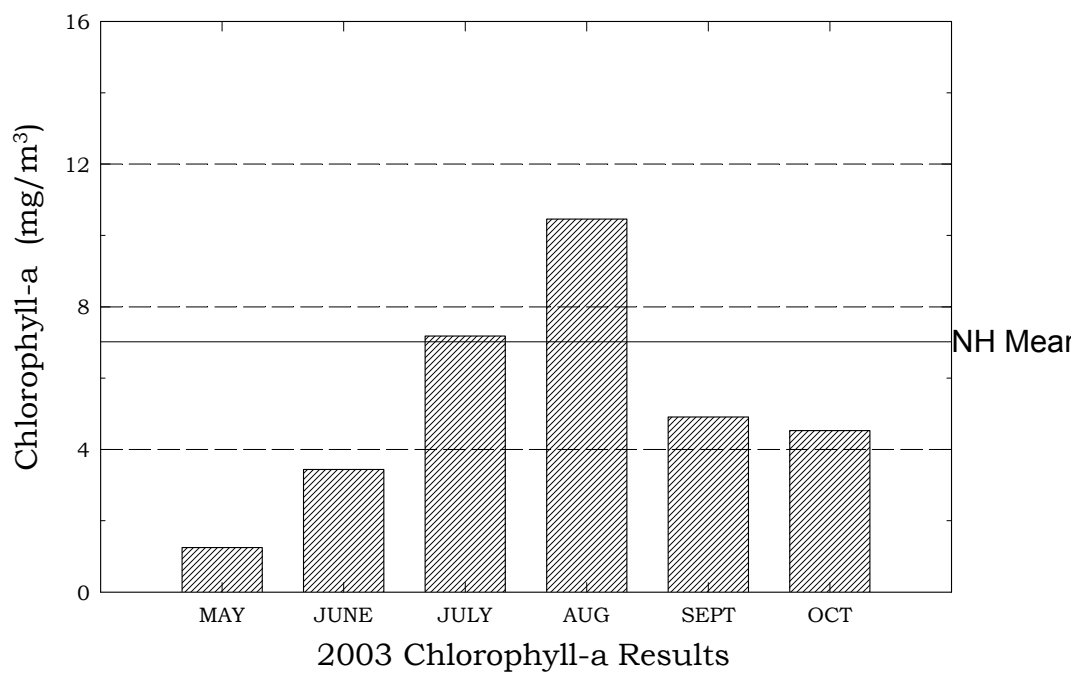
Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants, WD-BB-4, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-4.htm.

APPENDIX A

GRAPHS

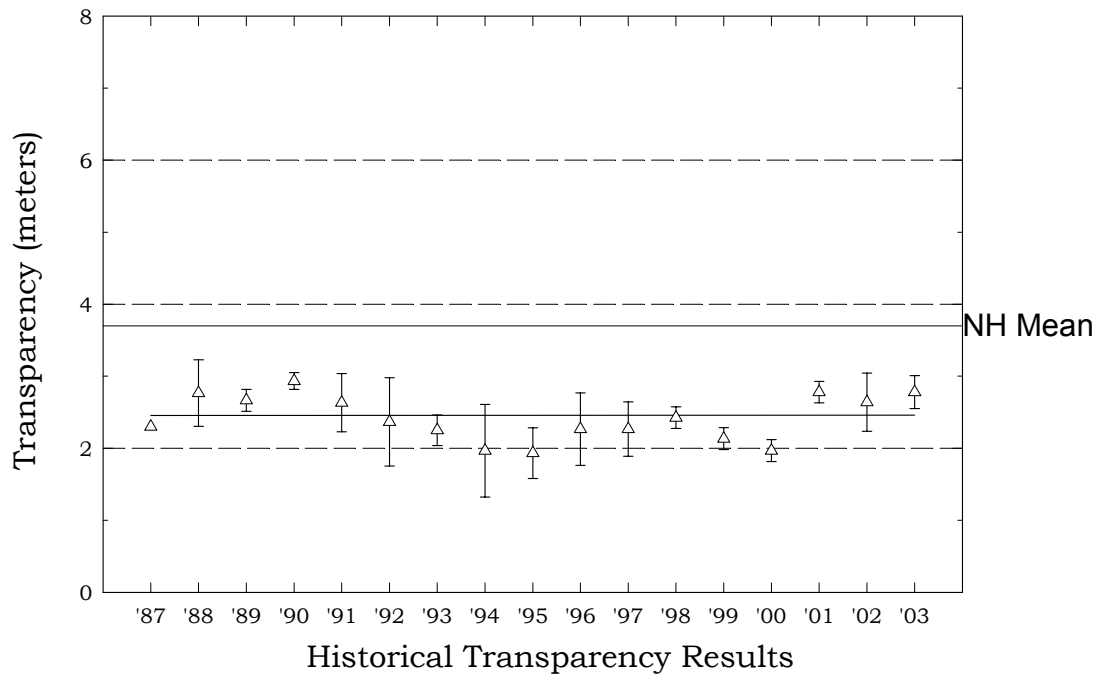
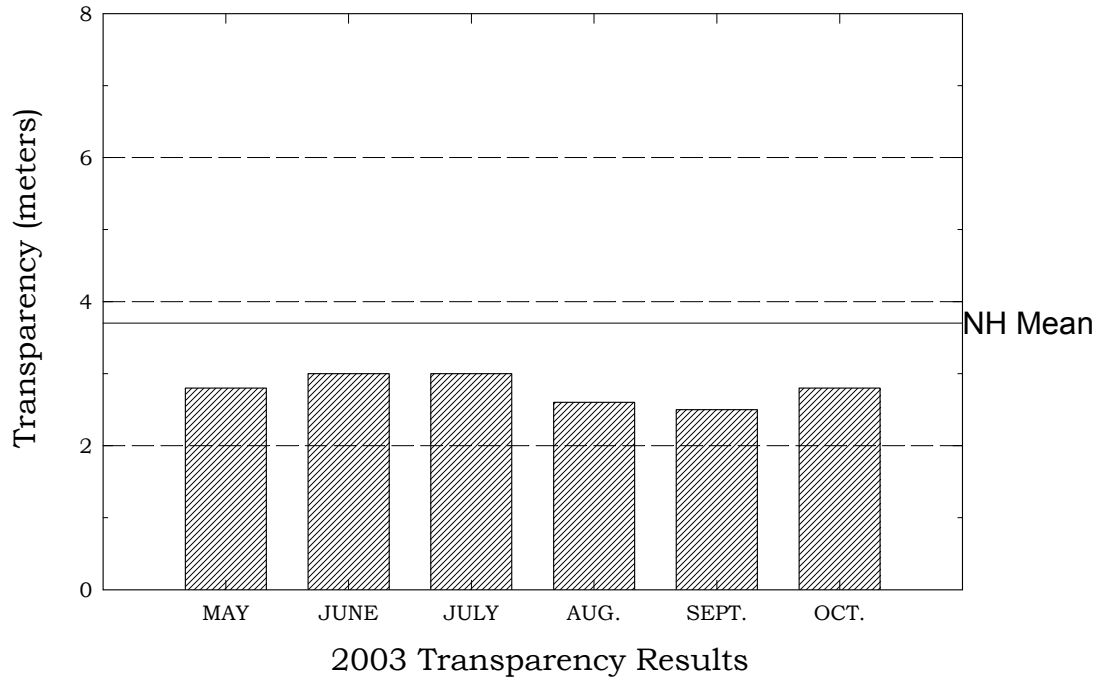
Perkins Pond, Sunapee

Figure 1. Monthly and Historical Chlorophyll-a Results



Perkins Pond, Sunapee

Figure 2. Monthly and Historical Transparency Results



Perkins Pond, Sunapee

Figure 3. Monthly and Historical Total Phosphorus Data.

